

THE MARIANAS FRUIT BAT: MANAGEMENT HISTORY, CURRENT STATUS AND FUTURE PLANS

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ABSTRACT: The Marianas fruit bat (*Pteropus mariannus*), a species endemic to the Mariana Islands, is now considered endangered on Guam and has been proposed for endangered status under the Endangered Species Act of 1973. This species, considered a delicacy among the indigenous people, has been under investigation by the Aquatic and Wildlife Resources Division of Guam since 1962. These investigations documented a steady decline in a population index throughout the 1960's. Thereafter, annual surveys revealed that only a few dispersed, solitary bats remained in the prime habitat on Guam which once supported colonies numbering in the hundreds of bats. Reasons for the decline include: increased population pressures resulting in over-hunting and permanent habitat loss, commercial exploitation of this food species, periodic severe typhoons, the lack of an adequate enforcement staff, and delays by the local legislatures in passing protective legislation. Future investigations of the Marianas fruit bat will include a monitoring program of the population of Guam, which is now completely protected by law, and fruit bat surveys of the islands of Rota, Tinian and Saipan. Life history data will be collected to the extent now possible. In the planning stages are the following projects: development of methods of capture and marking, a feasibility study of captive propagation, a more intensive study of life history and ecology, a public awareness campaign and increased law enforcement.

INTRODUCTION

The Marianas fruit bat (*Pteropus mariannus mariannus*) is currently being considered for endangered status under the Endangered Species Act of 1973. This relatively large fruit bat has a wing-span of approximately one meter as an adult and weighs up to 500 grams (Perez 1972). The population of this species on Guam has been declining at least since 1962, and it is now at a critically low level (Wheeler and Aguon 1978). The purpose of this paper is to summarize the management history of the Marianas fruit bat, covering a period of 16 years of investigations (1962-1978) by the Aquatic and Wildlife Resources Division (A.W.R.) of the Government of Guam, and to present what is known of the current status of this bat in the Mariana Islands. Finally, the steps that are currently planned for the conservation of this species will be outlined.

STUDY AREA AND BACKGROUND

The Mariana Islands consist of a chain extending over 800 km in a north-south direction between longitude 144° and longitude 146° (Figure 1). The main island, Guam, is approximately 8,000 km southwest of San Francisco, 2,400 km south of Tokyo, and 2,500 km east of Manila. Because of limited biological data, this paper will deal primarily with the islands of Guam (539 km²), Rota (85 km²), and Saipan (122 km²), with the greatest emphasis placed on Guam. These islands are, for the most part, worn down volcanoes, capped or surrounded by elevated limestone terraces.

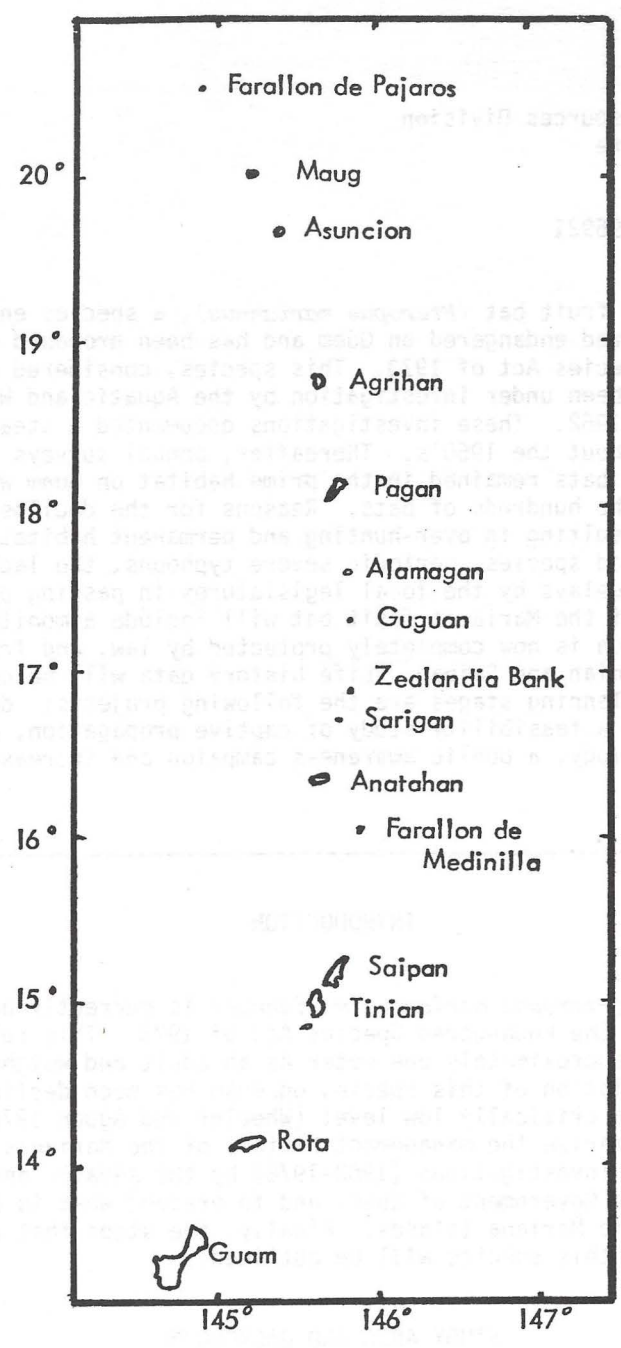


Figure 1. The Mariana Islands.

The vegetation types of the Mariana Islands include: forest of elevated hard limestone, ravine forest, swamps and marshes, strand vegetation and grassland (Fosberg 1960, Stone 1970). One of the most preferred habitats of fruit bats on these islands is limestone forest, which supports a variety of mixed, broad-leaved evergreens. In addition, fruit bats have been sighted in ravine forest and in coastal strand (A.W.R. 1962-1968). Through human disturbance, the most productive fruit bat habitat, limestone forest, has been diminishing in recent times (Fosberg 1960).

Guam is currently a United States territory, and the Government of Guam's Aquatic and Wildlife Resources Division receives 100% federal financing of wildlife investigations. Guam has had at least one full-time wildlife biologist since November, 1979, when the wildlife program was initiated. The remainder of the Mariana Islands became part of the Trust Territory of the Pacific under the United States administration subsequent to World War II. However, these islands became the Commonwealth of the Northern Marianas in January, 1978, and the new government has not yet initiated a wildlife management program. Under the Trust Territory administration, the wildlife resources of the Northern Marianas came under the jurisdiction of one Conservation Officer, who served the entire territory and was based on Palau (Owen 1969). Very little work has been done in the area of wildlife conservation in the Northern Marianas up to the present time. With a rapid loss in isolation and reciprocal increases in exploitation, new efforts in conservation are now required for these islands (Owen 1969).

The Marianas fruit bat, being considered an utmost delicacy among the indigenous people, is being subjected to unlimited commercial exploitation in the Northern Marianas. With this state of affairs, the time has come to evaluate the management history of the Marianas fruit bat; to ascertain what problems have arisen during that history; and to lay out plans for the future that will insure conservation of this unique and culturally important species.

METHODS

In 1957 a U.S. Fish and Wildlife Service biologist visited Guam to determine the feasibility of initiating a wildlife program. He estimated the fruit bat population on Guam to be not more than 3,000 bats. At that time two species of fruit bats were known to occur there: the Marianas fruit bat (*P. mariannus*), and the little Marianas fruit bat (*P. tokudae*), but field differentiation of these two species was determined to be unreliable. In 1962 monthly fruit bat count surveys were initiated on Guam in two limestone forest areas (Naval Communications Station and Tarague Cliffs) and in one mesic volcanic ravine forest (surrounding Fena Lake) (Perez 1972). These surveys were conducted continuously until 1968, and the results were used as an indication of the population trend (A.W.R. 1969). No attempts were made to determine the movement patterns or home range of fruit bats in the Marianas, however, there were a number of verified sightings of large migrating colonies of up to a thousand fruit bats. When reports of such large colonies were received, attempts were made by biologists to verify them and to determine the approximate length of their stay in the areas where they were sighted (A.W.R. 1962-1973).

In addition to these field endeavors, biological data were obtained in the 1960's on Guam by checking hunters' bags, and from collecting fruit bats for scientific purposes. These collections were made to determine various aspects of the breeding biology of the Marianas fruit bat. For each collected specimen, the species, sex, approximate age, and reproductive condition were determined (Perez 1973).

In 1970 there was a change in the biological staff at the Aquatic and Wildlife Resources Division, and there was a loss of continuity in the field research on the fruit bat. The new biologist discontinued the monthly fruit bat surveys and instead conducted fruit bat surveys once a year (A.W.R. 1970-1975). Unfortunately, very little quantitative data were reported for these surveys, and rarely were the times, dates, number of hours and locations given. Sightings of colonies were still recorded, but efforts to determine the duration of their stay in an area were unsuccessful, as were attempts to record behavioral and ecological data of colonial roosting bats. The island-wide fruit bat population was estimated for Guam (A.W.R. 1971, 1973), but apparently on the basis of little quantitative data.

In 1976 an additional wildlife biologist was added to the Division staff on Guam. Plans were formulated to conduct a study of fruit bat movements with the aid of radio-telemetry equipment, however, a prerequisite to these plans was to locate a suitable population of fruit bats. The biologists hoped that such a population could be located on Rota, so a two-day survey of Rota was conducted in January, 1977. No attempts were made to collect any field data on fruit bats on Guam in fiscal year 1977.

An intensive, island-wide fruit bat survey was conducted on Guam during the summer of 1978 (Wheeler and Aguon 1978). Field work consisted of repeated visits to 18 different locations (Figure 2), with emphasis placed on those areas known to have been utilized by fruit bats in the past. Several observation points were established in each survey area, and for each visit to an area, one-half hour to one hour was spent observing with binoculars at each observation point. Field work was concentrated in a three-hour period following sunrise and a three-hour period subsequent to sunset. A record was kept of all bat sightings, as well as their activity and behavior. The averages surveyed were estimated with the aid of topographic maps (scale of 1:24,000) and a dot grid, and the average and maximum number of bats sighted in each area.

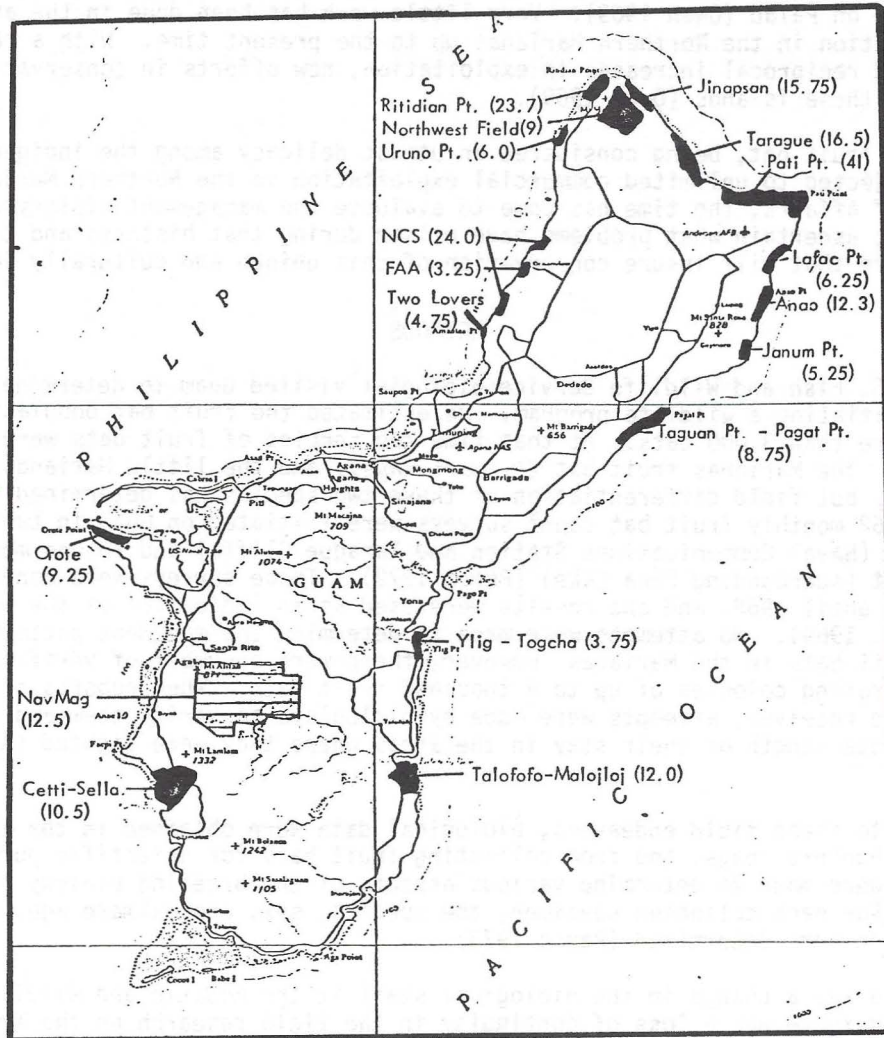


Figure 2. Survey locations and intensities (numbers indicate total observer hours) during a fruit bat study conducted in summer, 1978.

Fruit Bat Colony Sightings

Confusing the issue of population status were periodic sightings of large colonies of more than 100 fruit bats at various locations on Guam (Figure 3). It is possible that several of these sightings represent the same colony moving about to different locations. There has also been speculation that the presence of some of these colonies may have been the result of a mass migration of fruit bats from one island to another (Perez 1973). Such behavior is not uncommon in other members of this genus (Allen 1939). Another possibility is that a colony may be formed by the congregation of dispersed bats on Guam. Members of the genus *Pteropus* do have a tendency to aggregate, and large groupings are not merely the result of some fortuitous environmental circumstance (Eisenberg 1966). Eisenberg (1966) states that colonies are often permeable and not cohesive when the animals forage.

For the fiscal years (July - June) 1965 through 1967 data were available on the quarterly averages of monthly fruit bat surveys of three areas on Guam (Table 1). This index was expressed as average density (bats per 40.5 ha) for the areas surveyed. Several colony sightings were made during the years for which such quarterly data were available. At the time of three large colony sightings (2nd quarter 1965, 3rd quarter 1966, and 4th quarter 1966), the quarterly averages of monthly survey data were relatively high (Table 1). However, during one quarter (4th quarter 1965) the opposite was true. These data are too limited in detail and in quantity to make any correlation between bat density in the survey areas and the appearance of a large colony, however, it is possible that in the past the fruit bat populations on Guam consisted of two segments: a colonial roosting, migratory segment (Figure 4), and a more dispersed, less gregarious segment (Figure 5). A social organization of this nature has been described for a related species (*Pteropus geddiei*) in New Hebrides, where the sexual structure of large camps of fruit bats was found to change seasonally (Allen 1939). In this species, pregnant females leave the camp and live separately in February, but return in June when pregnancy is far advanced. The males begin living separately in June, and return to the large camps in September. Whether or not there are seasonal changes in the sexual structure of Marianas fruit bat groupings has not been determined. Opportunities to study the dynamics of colonial organization of fruit bats on Guam are now greatly diminished as this type of behavior is becoming less common as the island population of fruit bats decreases.

The survey of Rota conducted in January, 1977 located a group of 100-150 fruit bats, but no attempts were made to capture and mark any bats. It was felt at the time that populations were too low subsequent to super-typhoon Pamela to risk such an operation.

Non-colonial Bat Population Trend

The monthly bat surveys conducted between 1962 and 1968 were averaged to give an annual average density of bats for the areas surveyed. One year's datum (1968) for one survey area (Tarague cliffs) was not used because it included some observations of a visiting colony. The result (Figure 6) probably represents a good index of abundance for that part of the population counted during the non-colonial bat surveys. The index for this population segment demonstrates a steady, almost continuous, decline throughout these years. A comparable figure for 1972 was estimated at less than one bat per 40.5 ha. (A.W.R. 1972).

For the years 1970 through 1976, fruit bat surveys were conducted once a year, however, very little information was recorded and the surveys were not conducted systematically (A.W.R. 1970 - 1976). The exact locations and hours of the day were never reported, and only on two occasions were the dates given (Table 2). The results, though scanty, suggest an extremely low population level of fruit bats on Guam throughout the 1970's, while the last large colony of over 100 bats was sighted in 1973.

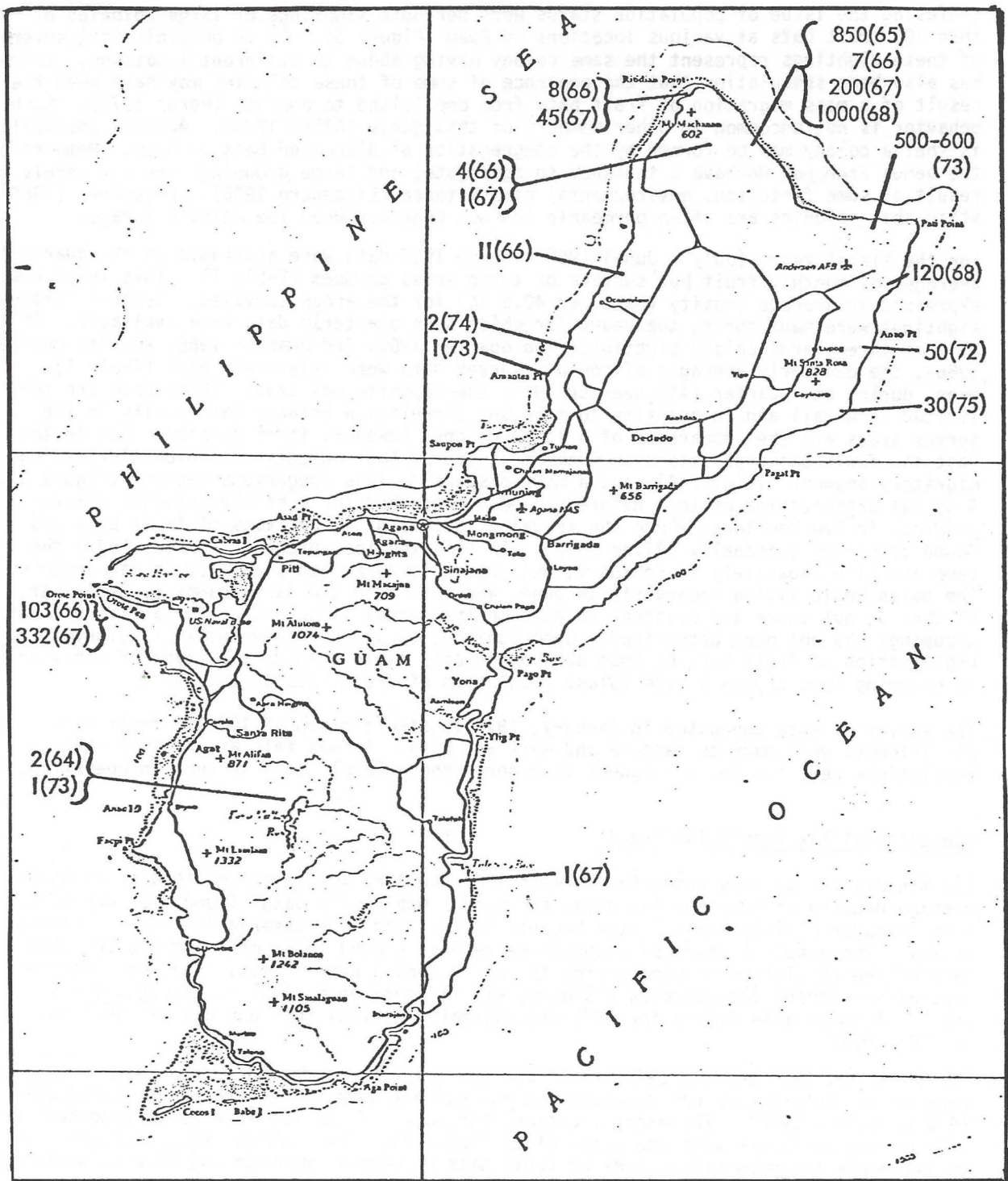


Figure 3. Fruit bat distribution from sightings recorded from 1964 to 1975. Numbers indicate number of bats sighted, while numbers in parentheses indicate the years of the sightings. Sightings were made by wildlife biologists and recorded at the Aquatic and Wildlife Resources Division.



Figure 5. A solitary roosting Marianas bat.



Figure 4. A portion of a large colony of roosting fruit bats.

TABLE 1. Sightings on Guam of fruit bat colonies composed of more than 100 individuals, with concurrent non-colonial bat survey results expressed as quarterly average bat density.

FISCAL YEAR	QUARTER	SURVEY AVE. (Bats/40 ha)	COLONY SIGHTINGS		
			Number of Bats	Location	Dates
1965	1st	14.2	1100	Anao	Oct. 6 - 20
	2nd	17.7			
	3rd	8.5	850	Tarague	May 18 - July 7
	4th	4.6			
1966	1st	17.2	100-300 600	Orote Pati Pt.	Jan. 11 - Apr. 19 Apr. - June
	2nd	7.2			
	3rd	10.0			
	4th	11.7			
1967	1st	10.4			
	2nd	9.4			
	3rd	16.3			
	4th	5.0			
1968	1st		200	Tarague	July 26 - ?
	2nd				
	3rd		120	Lafac Pt.	Oct. 2 - ?
	4th		1000	Tarague	Oct. 5
1969					
1970					
1971			150	Orote	
1972			500-600	Pati Pt.	June
1973			500-600	Pati Pt.	Jan.

TABLE 2. Data from non-colonial fruit bat surveys conducted annually on Guam during the years 1970 through 1976.

YEAR	TIME	DATES	LOCATIONS	NUMBER OF BATS SIGHTED
1970	-	-	-	-
1971	"Dawn & Dusk"	-	"Northern Section of Guam"	"8 or 10 bats"
1972	-	-	-	"less than 1 per 100 acres"
1973	-	-	-	-
1974	-	Mar. 5-12	"All known bat habitat on Guam"	10 bats
1975	-	-	"Walked 32 mi. in northern plateau"	Colony of 50
1976	-	Jun. 1-10	"Northern plateau from Harmon to Mangilao"	7 bats

NOTE: A dash indicates that information was not recorded.

In addition to the relative abundance as determined by surveys, the maximum island population of fruit bats on Guam has been subjectively estimated several times since 1957. These "guesstimates" also demonstrate a precipitous decline (Figure 7).

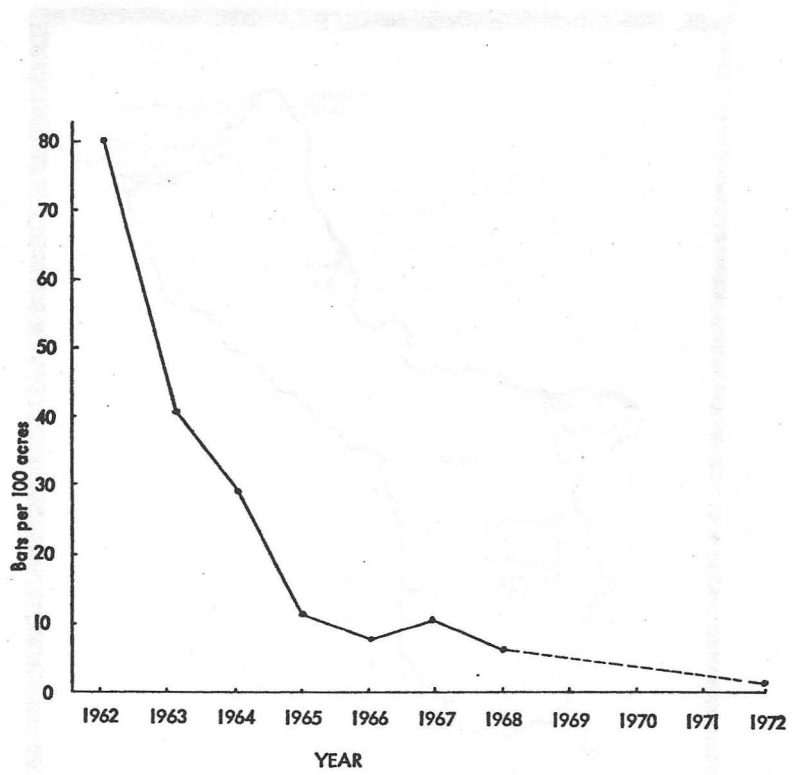


Figure 6. Annual average fruit bat density from monthly surveys conducted in three areas on Guam.

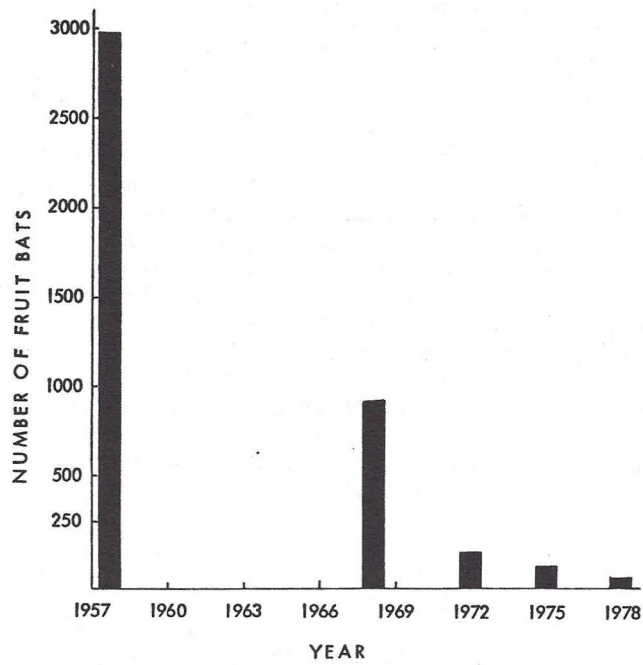


Figure 7. Estimated maximum fruit bat population on Guam.

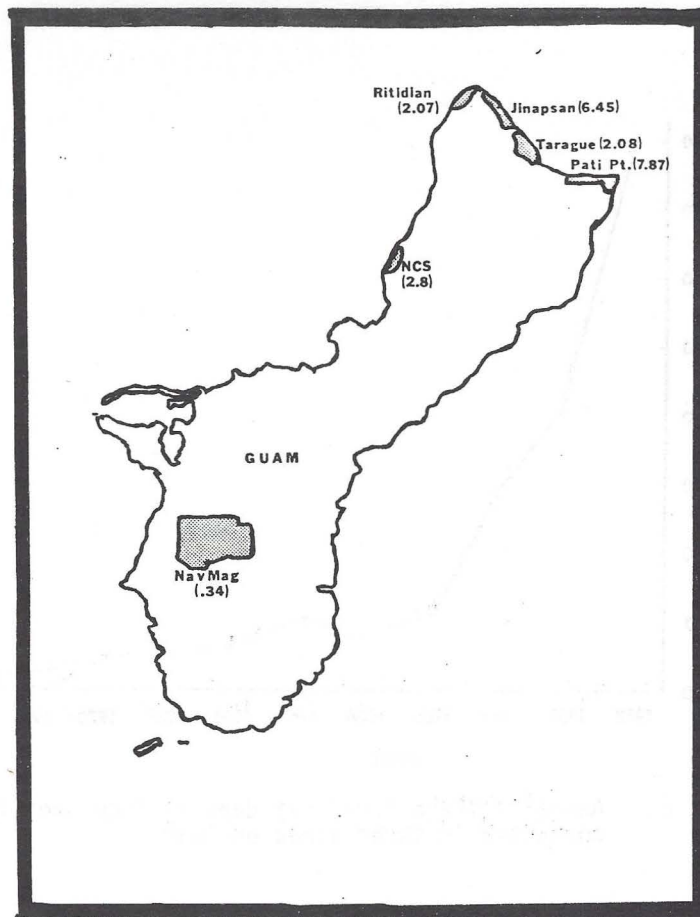


Figure 8. Maximum fruit bat densities (bats per 40 hectares surveyed) in six areas where bats were observed on Guam during an extensive survey conducted in summer, 1978.

Current Abundance and Distribution

The abundance and distribution of the Marianas fruit bat on Guam has recently been estimated from an intensive island-wide survey conducted in summer, 1978 (Wheeler and Aguon 1978). Of the 18 areas surveyed, fruit bats were sighted in only six. The acreages surveyed were estimated by use of a dot grid, and the average and maximum observed fruit bat densities were determined for each of these areas (Table 3). The fruit bat on Guam is now restricted to a narrow belt of coastal limestone forest on the north coast and to an area of ravine and swamp forest in the south-central region of Guam (Figure 8). The total population of fruit bats on Guam during the summer of 1978 was estimated to be fewer than 50 bats. The areas now occupied by fruit bats are United States military land holdings, and civilian access to them is restricted, however, the majority of illegal hunting incidents on Guam occur in these areas. With a population as low as that of fruit bats on Guam, just one conscientious bat poacher could precipitate further population declines, and there is little doubt that the Marianas fruit bat is currently seriously endangered on Guam.

Almost nothing is known about the abundance and distribution of the Marianas fruit bat on Rota, Tinian and Saipan. Other than the two day survey of Rota, the populations on these islands have never been assessed by a professional wildlife biologist. The newly formed commonwealth has yet to initiate a wildlife management program. Governor Carlos S. Camacho of the Commonwealth has recently indicated that the fruit bat populations on Tinian and Saipan are at a very low threatened or endangered level (Personal communication

TABLE 3. Fruit bat numbers and densities in six areas on Guam during summer, 1978.

LOCATION	AREA SURVEYED (ha)	NUMBER VISITS	AVERAGE HOURS PER VISIT	AVERAGE BATS PER VISIT	MAXIMUM BATS IN ONE VISIT	AVERAGE BAT DENSITY BATS/40 ha	MAXIMUM BAT DENSITY BATS/40 ha
Ritidian	98	11	2.2	1.9	5	.78	2.07
Tarague	78	5	3.3	1.2	4	.62	2.08
Jinapsan	88	7	2.25	3.8	14	1.29	6.45
Pati Pt.	103	14	3.0	4.4	20	1.73	7.87
NCS	29	9	2.7	.4	2	.56	2.78
Nav Mag	117	3	4.2	.3	1	.10	.34

1978). There is a serious need to survey these populations at the soonest possible date, to support the endangered status recommendation and to stop the unlimited commercial exploitation of this species.

Reproductive and Ecological Data

Of over 100 fruit bats collected during the 1960's, only one was a little Marianas fruit bat (*P. tokudae*), a species known only from Guam (Tate 1934). This result suggests the possible or near extinction of this species. For the Marianas fruit bat, sex ratio, adult female to juvenile ratio, the number of young per pregnancy, and the lack of a distinct breeding season were noted (Perez 1973). While several preferred foods of the Marianas fruit bat are known (Safford 1905, A.W.R. 1969, Perez 1972), more detailed information on foods habits is lacking. A few observations suggested that the colonial segment of the Marianas fruit bat population roosted in the day and carried out extensive nocturnal feeding (Perez 1973). The remaining bats on Guam are active during the day (Wheeler and Aguon 1978). The greatest diurnal activity was noted between the hours of 5:00 AM and 9:00 AM (1.36 bat sightings per observer hour), with an intermediate level of activity between the hours of 11:00 AM and 3:00 PM (.69 bat sightings per observer hour), and a relatively low level of activity between 4:00 PM and 8:00 PM (.36 bat sightings per observer hour).

During the summer, 1978 survey, single bat sightings accounted for 60.8% of all sightings, with the largest group sighted consisting of 15 bats. Sheer limestone cliffs were preferred as roosting sites, and several preferred roosting trees have been determined. Since these data are not exhaustive, work is continuing to generate this type of information. Other ecological unknowns include: the abundance and distribution of fruit bats on the islands of the Northern Marianas, movement patterns and home range, longevity, birth rate, death rate and habitat requirements. To generate such information will require extensive field observations, a long-term capturing and marking study, and a long-term captive bat study.

History of Management Recommendations and Actions

Up to 1966 the fruit bat was considered an unprotected animal on Guam, and this animal could be hunted throughout the year without restrictions. In 1964 the wildlife biologist recommended that the fruit bat be removed from the unprotected list and be declared a game animal, consequently, an act to change the status of the fruit bat was initiated in the Guam Legislature. The Legislature failed to pass such an act in 1964. Opponents felt that the capture and consumption of fruit bats was so intricately a part of the indigenous people's cultural heritage that it should not be subject to regulation. This legislation finally passed during the last session of the 1965 Legislature. In 1966, a bag limit (4 bats) and two one-month seasons were initiated, and a possession limit of 12 bats per season was established. In addition, bat hunting was prohibited within a colony, which was defined as a gathering of 20 or more fruit bats within an area of 10,000 square feet. While the initial restrictions were far from satisfactory for purposes of conservation, a moral battle was won in the sense of getting restrictions passed at all.

In 1969 the two one-month seasons were discontinued in favor of one-month fall season only, with a bag limit of four and a season limit of 12. In 1971 the Division recommended that the season on bats be closed until such time as the fruit bat population recovered. Season closure was again recommended in 1972, and the legal hunting of fruit bats was finally discontinued on Guam on February 21, 1973. By this time, however, the demand for fruit bats was such that they commanded a price of up to \$15 in local stores, and even when there were legal seasons for taking bats, a considerable amount of illegal hunting was taking place. In 1973 recommendations were made to increase the law enforcement effort in order to stop bat poaching. While federal funds were available for biological investigations, the enforcement staff was financed with local funds. Efforts to increase appropriations for fish and wildlife enforcement activities have not met with much success. The current staff of five conservation officers is still insufficient to deal with the amount of illegal hunting occurring on Guam (A.W.R. 1978).

By 1977 a considerable traffic in frozen Marianas fruit bats had developed, with bats being imported from Rota, Tinian and Saipan. Since the population of fruit bats on Guam had become so severely depleted, enterprising individuals began importing fruit bats from other islands for sale in retail stores. The wildlife biologists on Guam began monitoring importations to ascertain the extent of this activity, and to recommend hunting and export regulations to the islands involved in exporting. Inspections of shipments revealed that hunters were harvesting indiscriminately, taking mothers with young and sexually immature bats. In 1977 and again in 1978, administrative personnel responsible for resource management in the Trust Territory and the Northern Marianas were advised of the current traffic in fruit bats, and recommendations were made to limit hunting and export of bats to a level compatible with sustained yield. No action has yet been taken on these recommendations.

The Municipality of Rota has had in effect a September 1 to December 31 season on fruit bats since 1970. Unfortunately, there has been little enforcement of this season since fruit bats were imported to Guam from Rota at all times of the year (A.W.R. 1978). There is no bag limit on Rota.

Tinian and Saipan have no restrictions on the taking of fruit bats and these islands have never had any such restrictions. The Northern Marianas Legislature passed a one-year moratorium on the capturing or taking of fruit bats on the islands north of Saipan (Public Law 5-21, September 9, 1977). This moratorium, which is no longer in effect, provided protection mostly for a different subspecies (*P. m. paganensis*) than that found on Guam, Rota, Tinian and Saipan (*P. m. mariannus*). The Government of the Northern Marianas is aware of the need for more strict conservation practices, but fears a big outcry of opposition from local residents if action is taken to close the hunting of this animal entirely and permanently. In January, 1979 Aguijan, a small (7.8 km²) uninhabited island just south of Tinian was declared a wildlife refuge, and the taking of fruit bats on this island is now prohibited.

Reasons for the Decline

The decline of the Marianas fruit bat may be attributable to several compounding factors. These include: increased population pressures resulting in over-hunting and permanent habitat loss, commercial exploitation of this food species, delays or failure of the local legislatures in passing protective legislation, the lack of an adequate enforcement staff, and periodic severe typhoons.

It has been a custom among the indigenous people of the Mariana Islands to consume fruit bats on very special occasions. Such utilization presented no problems when the human population was low and fruit bats numbered in the many thousands throughout the archipelago. However, events occurring in recent times have changed this situation. Concurrent with the decline of fruit bats on Guam has been a logarithmic increase in the civilian population (Figure 9), and the existing civilian population is expected to double by the year 2000 (Bureau of Planning 1977).

At the same time as this population explosion there have been increases in economic activities, resulting in urban expansion (Bureau of Planning 1977) and decreases in native forests that once covered the entire northern half of Guam (Fosberg 1960). Thus, recent human activities have resulted in significant losses in fruit bat habitat, but the Government of Guam has developed a land-use plan to prevent the further loss of unique terrestrial ecosystems such as limestone forest to continued expansion.

While urban and rural expansion may be controlled by way of a comprehensive land-use plan, the problem of accommodating the demand for hunting recreation is more complex than merely preserving wildlife habitat. The projected 1971 demand for hunting by the indigenous people (46,000 annual activity days) is expected to double by 1985 (97,000 annual activity days) (Johnsrud et al. 1966). This rising demand has been coincident with increased restrictions placed on legal hunting on Guam (A.W.R. 1970-1978), while the enforcement staff of the Aquatic and Wildlife Resources Division has not been significantly increased. The result has been a consistent and widespread illegal hunting problem (A.W.R. 1976-1978). While much of the illegal hunting effort is directed toward spotlighting deer at night (A.W.R. 1978), incidents of fruit bats being shot are occasionally reported (Wheeler and Aguon 1978).

CAL-NEVA WILDLIFE TRANSACTIONS 1979

As a consequence of over-hunting, fruit bat populations on Guam have suffered. The large migrating colonies that were periodically sighted in the past are no longer present. The colonial roosting habit of the Marianas fruit bat was not an asset in terms of hunter pressure. One hunter could easily kill or wound many bats when they roosted in dense clusters on trees within a relatively small area, and roosting bats were easily approached in the daytime to within 20 feet before a flight response was initiated (A.W.R. 1971). Large colonies of more than 100 fruit bats have not been sighted on Guam since 1973, and it is possible that hunting activities may be responsible. In addition, the remnant of the bat population has become severely depleted.

To supplement the market on Guam for this delicacy, a few enterprising individuals began importing Mariana fruit bats from Rota, Tinian and Saipan for sale in retail markets. Such imports amounted to 2,019 bats in fiscal year 1976 (A.W.R. 1976) and have increased to 2,032 bats for a 9-month period in fiscal year 1978 (A.W.R. 1978). Of the 1978 imported bats, 919 were imported from Rota, 325 were imported from Tinian, and 788 were imported from Saipan. While the abundance of fruit bats on these islands is not accurately known, it is very unlikely that these populations can sustain this amount of exploitation if stopped, a very real possibility of extinction exists.

One final compounding factor in the decline of the Marianas fruit bat has been that the Mariana Islands are subject to periodic severe typhoons (Table 4). Temporary habitat and food resource losses have resulted from the most severe of these typhoons, particularly typhoons Karen (1962) and Pamela (1976). Typhoons as severe as these denude the vegetation, thus decreasing fruit bat food and cover, and allowing for increased hunting activities. The fruit bat mortality as a consequence of typhoons can only be guessed, but these typhoons coming at a time when human population pressures were on the rise and bat populations on the decline probably accelerated the rate of decline.

TABLE 4. Typhoons affecting Guam (1946 to 1976).*

DATE	NAME	MAXIMUM SUSTAINED WIND SPEED ON GUAM (knots)
05/21/76	Pamela	120
11/19/75	June	90
04/11/68	Jean	38
11/13/67	Gilda	40
09/05/64	Sally	70 (est)
12/25/63	Susan	37
07/11/63	Wendy	70 (est)
04/29/63	Olive	54
11/11/62	Karen	150
09/10/61	Nancy	60 (est)
11/15/57	Lola	107
08/10/53	Nina	75
11/17/49	Allyn	79
09/21/46	--	100

*From Fleet Weather Central, Joint Typhoon Warning Center, Guam, Mariana Islands

FUTURE PLANS

Surveys and Monitoring Program

Subsequent to the recent summer survey, a monitoring program was initiated on Guam for which five areas occupied by fruit bats are visited twice monthly in the morning hours to record the presence and activity of bats. This monitoring program will continue indefinitely in order that future population trends may be noted. The monitoring program is also providing some ecological information, such as roosting tree selection and potential forage tree species.

A proposal has been drafted and funding has been secured to conduct fruit bat surveys on the islands of Rota, Tinian and Saipan in 1979. Survey data will be used to estimate the observed density of fruit bats in several areas, and the results will be compared to similar data for Guam. We plan to conduct these surveys in winter and again in summer so that the possibility of seasonal migrations between islands may be addressed. Inter-island migrations by fruit bats have been suspected for years with no substantial data. Proportional changes in island populations may suggest that such a phenomenon does occur. The survey results will be used to make management recommendations to the Territorial, Commonwealth and Federal governments. Also, it is hoped that a population suitable for more intensive study of life history and ecology will be located.

The Study of the Marianas Fruit Bat

In view of the need for research and restoration of this culturally important species, the ongoing, federally funded study of the fruit bat should continue at least through the next decade. The following projects are being considered for investigation under this study:

1. Literature review of the genus *Pteropus* through computerized searches.
2. Construction of a fruit bat holding facility.
3. Experimentation with methods of capture on Rota if a sizeable population is located there.
4. Development of methods of marking live bats.
5. Construction of a fruit bat flight cage.
6. Attempt to breed the Marianas fruit bat in captivity.
7. A study of marked, released bats.
8. A multivariate analysis of habitat, food resource and environmental factors that determine fruit bat use of specific areas at specific times.

Proposal for Recovery

The planned projects of the ongoing fruit bat study are part of a preliminary proposal for the recovery of the Marianas fruit bat on Guam. The recovery plan recommends a minimum five year project, employing two full-time biologists. Adequate sources of funding have not yet been secured, but it is hoped that funding will be available under Section 6 of the Endangered Species Act of 1973 once a Cooperative Agreement is approved and a determination of endangered status made. Included in the recovery proposal are the following projects:

1. Plans to initiate intensive studies of the life history and ecology of the Marianas fruit bat in the Northern Marianas.
2. A project to determine the feasibility of captive propagation on Guam.
3. A public awareness campaign.
4. Efforts to increase the enforcement staff.
5. Acquisition of that part of the critical habitat that is now under private ownership.

With early planning and the proper support for research and enforcement, the decline of the Marianas fruit bat can be reversed.

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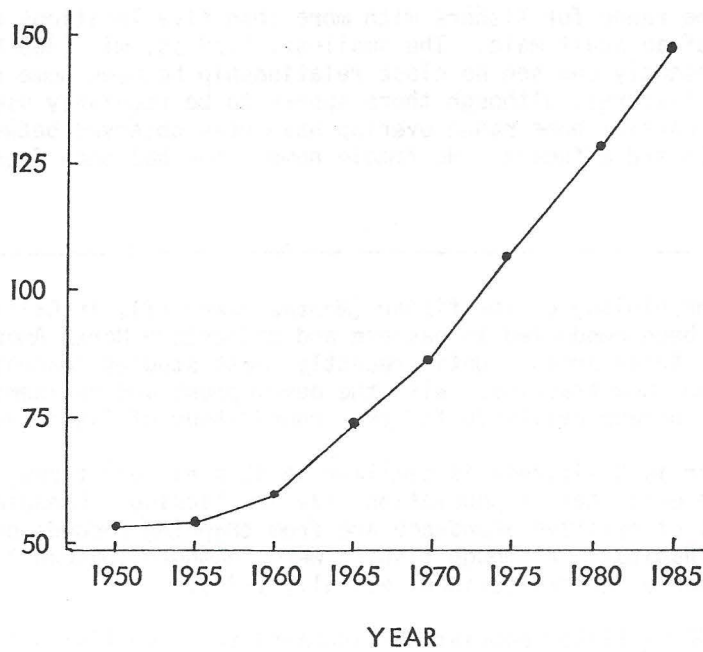


Figure 9. Human population projection for Guam (Bureau of Planning 1977).